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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/918,136	07/30/2001	Jianming Fu	AM2390.D2	3336

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APPLIED MATERIALS, INC.  
2881 SCOTT BLVD. M/S 2061  
SANTA CLARA, CA 95050

EXAMINER
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CANTELMO, GREGG

ART UNIT	PAPER NUMBER
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1745

DATE MAILED: 08/18/2003

16

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/918,136

Applicant(s)

FU, JIANMING

Examiner

Gregg Cantelmo

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 7/25/03.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 6-11 and 14-43 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 6-11 and 14-28 is/are allowed.
- 6) ☒ Claim(s) 29-37, 39-41 and 43 is/are rejected.
- 7) ☒ Claim(s) 38 and 42 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)                      4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)                      5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_                      6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on July 25, 2003 has been entered.

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 29, 31 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 09-041135 A (JP '135) in view of JP 10-152774 (JP '774).

JP '135 discloses a sputtering method for depositing a material onto a substrate in a system including a magnetron (Fig. 1) disposed on a side of the target opposite the pedestal (Fig. 5) along a central axis including an outer pole 6 and inner pole 5 each having an opposing magnetic polarity (fig. 6), the magnetron is rotated about the central

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axis via means 8 (Fig. 5), a working gas is flown into the vacuum chamber and DC power 9 is applied to the target.

The differences between JP '135 and claim 29 are that JP '135 does not disclose depositing a metal film (claim 29) and more particularly of the metal being titanium (claim 31) or providing an unbalanced magnetron arrangement (claims 29 and 37).

The concept of providing opposing magnets wherein the magnetic strength of one of the poles relative to the opposite pole is greater or lesser (in other words unbalanced) is well known to one of ordinary skill in the art and therefore not a novel contribution to the art.

JP '774 discloses of providing first and second magnets of opposite polarity wherein the magnetic field strength of one of the poles is 6 times greater than the opposite polarity pole (paragraph [0031]). This arrangement is used to deposit metals such as titanium.

The motivation for employing an unbalanced magnetron is that it improves the control of the angle of incidence of the sputtered particles and improves film deposition in substrates having high aspect ratios.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of for employing an unbalanced magnetron since it would have improved the control of the angle of incidence of the sputtered particles and improved film deposition in substrates having high aspect ratios.

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The motivation for selecting the target material to be titanium is dependent upon the manufacturing process. For example, use of refractory metals in filling aspect ratios on a substrate is a process which employs sputtering a target such as titanium to provide a conformal coating in each void on the substrate.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '135 by selecting the target material to be titanium since selection of the target material is dependent upon the manufacturing process being employed. Thus one of ordinary skill in the art would have found the selection of titanium targets to be obvious in the manufacture of semiconductor devices as taught by JP '774 and selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07

4. Claims 30, 32-36 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP '135 in view of JP '774 as applied to claim 29 above, and further in view of U.S. patent No. 5,723,367 (Wada).

The differences not yet discussed are the metal target being Ta (claim 30) or W (claim 32), of admitting gaseous nitrogen into the chamber to form a nitride of the metal (claim 33), of the metal in forming the metal nitride is Ta (claim 34), Ti (claim 35) or W (claim 36), of providing an RF bias to the substrate (claim 39).

With respect to claims 30 and 32-36:

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Wada teaches that it is known in the art to employ target materials such as Ti, Ta and W in DC magnetron sputtering systems for fabricating semiconductor devices (col. 24, ll. 46-56 as applied to claims 30, 32, 34-36).

In the manufacturing process of Wada, a nitrided refractory metal film is formed atop a refractory metal layer by introducing nitrogen into the chamber (col. 9, ll. 11-22).

The motivation for using the materials and process steps of Wada is dependent upon the intended manufacturing process. One of ordinary skill in the art of semiconductor fabrication methods employs DC magnetron sputtering of refractory metals and refractory metal nitrides would have found the modifications above obvious since it would have provided a desired conductive barrier layer typically employed in wiring patterns in semiconductor devices.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '135 by using W, Ta or Ti as the deposited metal and further sputtering these materials in the presence of nitrogen to form a metal nitride layer since such materials are shown by Wada to be used in DC magnetrons sputtering process for fabricating conductive barrier layers in a semiconductor device and selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

With respect to claim 39:

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Wada teaches of applying an RF bias to the substrate during processing (Fig. 2 and col. 9, ll. 46-52). The bias attracts ions from the plasma and improves the planarization of the film formed in the substrate.

The motivation for providing an RF bias to the substrate is to attract ions to the coating and improve the planarization of the film.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '135 by providing an RF bias to the substrate since it would have attracted ions to the coating and improved the planarization of the film.

5. Claims 40, 41 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP '135 in view of JP '774 and Wada.

JP '135 discloses a sputtering method for depositing a material onto a substrate in a system including a magnetron (Fig. 1) disposed on a side of the target opposite the pedestal (Fig. 5) along a central axis including an outer pole 6 and inner pole 5 each having an opposing magnetic polarity (fig. 6), the magnetron is rotated about the central axis via means 8 (Fig. 5), a working gas is flown into the vacuum chamber and DC power 9 is applied to the target.

The differences between JP '135 and claim 29 are that JP '135 does not disclose depositing a tantalum film (claim 40), providing an unbalanced magnetron arrangement (claims 40 and 41) of providing an RF bias to the substrate (claim 40) of admitting nitrogen into the vacuum chamber (claim 43).

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The concept of providing opposing magnets wherein the magnetic strength of one of the poles relative to the opposite pole is greater or lesser (in other words unbalanced) is well known to one of ordinary skill in the art and therefore not a novel contribution to the art.

JP '774 discloses of providing first and second magnets of opposite polarity wherein the magnetic field strength of one of the poles is 6 times greater than the opposite polarity pole (paragraph [0031]). This arrangement is used to deposit metals such as titanium.

The motivation for employing an unbalanced magnetron is that it improves the control of the angle of incidence of the sputtered particles and improves film deposition in substrates having high aspect ratios (as applied to claims 40 and 41).

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of for employing an unbalanced magnetron since it would have improved the control of the angle of incidence of the sputtered particles and improved film deposition in substrates having high aspect ratios.

Wada teaches that it is known in the art to employ target materials such as Ti, Ta and W in DC magnetron sputtering systems for fabricating semiconductor devices (col. 24, ll. 46-56 as applied to claim 40).



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In the manufacturing process of Wada, a nitrided refractory metal film is formed atop a refractory metal layer by introducing nitrogen into the chamber (col. 9, ll. 11-22 as applied to claim 43).

The motivation for using the materials and process steps of Wada is dependent upon the intended manufacturing process. One of ordinary skill in the art of semiconductor fabrication methods employs DC magnetron sputtering of refractory metals and refractory metal nitrides would have found the modifications above obvious since it would have provided a desired conductive barrier layer typically employed in wiring patterns in semiconductor devices.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '135 by using W, Ta or Ti as the deposited metal and further sputtering these materials in the presence of nitrogen to form a metal nitride layer since such materials are shown by Wada to be used in DC magnetrons sputtering process for fabricating conductive barrier layers in a semiconductor device and selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

Wada teaches of applying an RF bias to the substrate during processing (Fig. 2 and col. 9, ll. 46-52). The bias attracts ions from the plasma and improves the planarization of the film formed in the substrate.

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The motivation for providing an RF bias to the substrate is to attract ions to the coating and improve the planarization of the film.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '135 by providing an RF bias to the substrate since it would have attracted ions to the coating and improved the planarization of the film.

***Allowable Subject Matter***

6. Claims 6-11 and 14-27 are allowed for reasons set forth in the previous office actions, incorporated herein. Claim 28 is also allowed as being dependent upon base claim 6.

7. Claims 38 and 42 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter: none of the prior art of record are considered to teach, suggest or render obvious the limitation of claims 38 and 42, in that the periphery of the magnetron is no more than 1/6 of a usable area of the target.

The prior art of record teaches of magnetrons which cover a greater portion of the target and notably much greater than 1/6 of a usable area of the target.

Therefore the size of the magnetron is significantly smaller than the target usable area.

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**Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregg Cantelmo whose telephone number is (703) 305-0635. The examiner can normally be reached on Monday through Thursday from 8:00 a.m. to 5:30 p.m. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan, can be reached on (703) 308-2383. FAX communications should be sent to the appropriate FAX number: (703) 872-9311 for After Final Responses only; (703) 872-9310 for all other responses. FAXES received after 4 p.m. will not be processed until the following business day. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Gregg Cantelmo  
Patent Examiner  
Art Unit 1745

gc

  
August 10, 2003